(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: 0 274 894
A1

(12) # EUROPEAN PATENT APPLICATION

(21) Application number: 87311271.8

(51) Int. Cl.[4]: G03G 15/02

(22) Date of filing: 22.12.87

(30) Priority: 22.12.86 US 945055

(43) Date of publication of application:
20.07.88 Bulletin 88/29

(84) Designated Contracting States:
DE FR GB

(71) Applicant: XEROX CORPORATION
Xerox Square - 020
Rochester New York 14644(US)

(72) Inventor: Gundlach, Robert W.
2434 Turk Hill Road
Victor New York 14564(US)
Inventor: Bergen, Richard
1043 Willits Road
Ontario New York 14519(US)

(74) Representative: Frain, Timothy John et al
Rank Xerox Limited Patent Department 364
Euston Road
London NW1 3BL(GB)

(54) ## Corona charging device.

(57) A flat scorotron device (200) includes pin electrodes (212) and a charge level control electrode (215) coplanar on the surface of an insulator (220). The pin electrodes are connected to a high voltage D.C. bus bar (205, 210) through a resistive material (230) and a relatively low voltage is applied to the electrode (215). A low watt heater (211) is attached to one surface of the insulator to negate the effects of high relative humidity environment on the device.

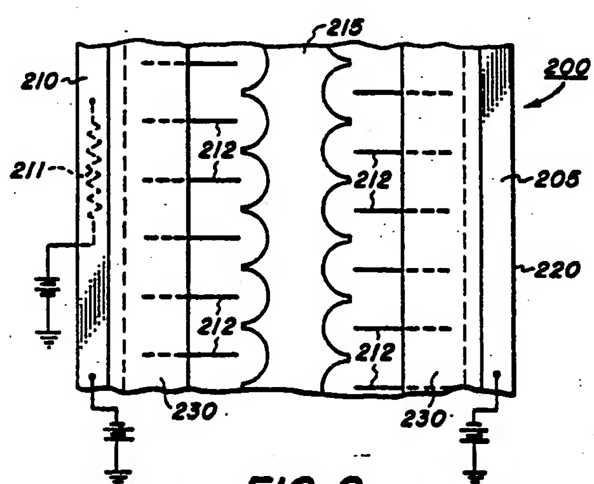


FIG. 2

EP 0 274 894 A1

CORONA CHARGING DEVICE

The present invention relates to a corona charging device for depositing electrons or negative ions onto an adjacent surface. More particularly, (but not exclusively) it is directed to a corona charging arrangement usable in a xerographic reproduction system for generating a flow of ions onto an adjacent imaging surface for altering or charging the electrostatic charge thereon.

In the electrophotographic reproducing arts, it is necessary to deposit a uniform electrostatic charge on an imaging surface, which charge is subsequently selectively dissipated by exposure to an information containing optical image to form an electrostatic latent image. The electrostatic latent image may then be developed and the developed image transferred to a support surface to form a final copy of the original document.

In addition to precharging the imaging surface of a xerographic system prior to exposure, corona devices are used to perform a variety of other functions in the xerographic process. For example, corona devices aid in the transfer of an electrostatic toner image from a reusable photoreceptor to a transfer member, the tacking and detacking of paper to the imaging member, the conditioning of the imaging surface prior to, during, and after the deposition of toner thereon to improve the quality of the xerographic copy produced thereby.

Both D.C. and A.C. type corona devices are used to perform many of the above functions.

The conventional form of corona discharge device for use in reproduction systems of the above type is shown generally in US-A-2,836,725 in which a conductive corona electrode in the form of an elongated wire is connected to a corona generating D. C. voltage. The wire is partially surrounded by a conductive shield which is usually electrically grounded. The surface to be charged is spaced from the wire on the side opposite the shield and is mounted on a grounded substrate. Alternately, a corona device of the above type may be biased in a manner taught in US-A-2,879,395 wherein an A.C. corona generating potential is applied to the conductive wire electrode and a D.C. potential is applied to the conductive shield partially surrounding the electrode to regulate the flow of ions from the electrode to the surface to be charged. Other biasing arrangements are known in the prior art and will not be discussed in great detail herein.

Several problems have been historically associated with such corona devices. A first problem has been inability of such devices to deposit relatively uniform negative charge on an imaging surface.

More specifically, when a corona electrode in a device of the above type is biased with a negative corona generating potential, the charge density varies greatly along the length of the wire resulting in a corresponding variation in the magnitude of charge deposited on associated portions of an adjacent surface to be charged. This problem is visually verified as glow spots along the length of the corona wire when negative corona potentials are applied as contrasted to the more uniform corona glow when positive potentials are applied. More basically, the nonuniformity is believed to result from the fact that negative corona is initiated by high field stripping of electrons from the surface of the wire and sustained in large measure by secondary emission processes at the surface. This secondary emission process is easily affected by surface contamination which typically occurs from chemical growths on these surfaces. Positive ion bombardment also is believed to contribute to the nonuniformity problem by partially cleaning portions of the wire, which cleaned portions become emitters of relatively high current with respect to the remainder of the wire.

Other problems include singing and sagging of corona wire, contamination of corona wires, and costly manufacture of corona devices and humidity effects on corona devices.

Various approaches to answering these problems have been tried in the past. For example, US-A-4,086,650 suggests the use of a corona discharge device that includes an A. C. corona discharge electrode located adjacent a conductive shield with the electrode being covered with relatively thick dielectric material so as to substantially prevent the flow of conduction current therethrough. The delivery of charge to a photoconductive surface is accomplished by means of displacement current or capacitance coupling through the dielectric material. EP-A-0 102-569 shows a large variety of corotrons with wire shaped corona discharge electrodes 3, 4 and 5 in Figure 3 disposed on the surface of a cylinder. US-A-4,353,970 discloses a bare wire coronode attached directly to the outside of a glass coated secondary electrode in Figure 5. Point coronodes are shown in an electrode arrangement in Figure 10 with their points sticking out away from between two glass plates. A corona discharge electrode in contact with or closely spaced from a conductive shield electrode is shown in US-A-4,057,723. The discharge electrode includes a conductive wire coated with a relatively thick dielectric material. The dielectric is preferably glass, but can be an organic dielectric. US-A-4,341,463 discloses two sets of wire coronodes with shields spaced equidistantly around each cor-

onode. The two sets of coronodes are spaced in parallel and not in alternating fashion. In US-A-4,339,782, a barb coronode with a ring shaped shield spaced equidistantly around the barb tip is shown. The shield is perpendicular to the barb and not in the same plane as the barb. US-A-4,591,713 discloses a barb coronode with a shield perpendicular to the barb. In US-A-3,717,801, column 6, lines 10 - 12, coronodes of a shieldless corotron are disclosed as taking the form of thin conductive strips which are suitably painted or etched on an appropriate insulating material such as glass or plastic. US-A-4,511,244 discloses cleaning a corona wire by generating resistance heating through applying a small EMF directly to the coronode. In Japanese Patent No. 59-58453 suggests placing a resistor on the back side of a shield which supports a coronode, thereby to heat the air around the coronode and a photosensitive surface being charged in order to try and stabalize the electrified state on the photoreceptor. These inventions were partially successful in eliminating some of the problems mentioned hereinbefore, therefore other solutions are needed.

Accordingly, in accordance with the present invention as claimed hereinafter, a flat scorotron is provided that improves mechanical tolerance, offers low manufacturing costs, greater reliability, requires little maintenance, is easily serviced and includes humidity control means. The flat scorotron comprises pin electrodes and reference electrodes coplanar on the surface of an insulator. Self biasing of the configuration is limited, since charging of an insulating substrate will quickly shut off charge flow to it, but will not quench the corona emissions from the pin coronodes. An optional heater can be placed on the insulator in order to reduce relative humidity in the region of the coronodes.

In the accompanying drawings:-

Figure 1 is a schematic elevational view showing an electrophotographic copier employing the features of an aspect of the instant invention.

Figure 2 is an enlarged plan view of the flat scorotron employed as in the charging unit in Figure 1.

Figure 3 is an enlarged plan view of an alternative embodiment of the flat scorotron of Figure 2.

Figure 4 is an enlarged plan view of an alternative flat scorotron for use in the charging unit in Figure 1.

Figure 4A is an enlarged elevational view of the flat scorotron of Figure 4.

Figure 5 is an enlarged plan view of an alternative flat scorotron embodiment in accordance with the present invention.

Figure 6 is an enlarged partial elevational view of the flat scorotron of Figure 5 including the location of a charg retentive member.

While th present invention will her inafter be described in connection with preferred embodiments thereof, it will be understood that it is not intended to limit the invention to those embodiments. On the contrary, intended for coverage are all alternatives, modifications and equivalents as may be included within the scope of the invention as defined by the appended claims.

For a general understanding of the features of the present invention, reference is had to the drawings. In the drawings, like reference numerals hav been used throughout to designate identical elements. Figure 1 schematically depicts the various components of an illustrative electrophotographic copying machine incorporating the improved flat scorotron apparatus of the present invention therein.

Inasmuch as the art of electrophotographic copying is well known, the various processing stations employed in the Figure 1 copying machine will be shown hereinafter schematically and their operation described briefly with reference thereto.

As shown in Figure 1, the illustrative electrophotographic printing machine employs a belt 10 having a photoconductive surface thereon. Preferably, the photoconductive surface is made from a selenium alloy. Belt 10 moves in the direction of arrow 12 to advance successive portions of the photoconductive surface through the various processing stations disposed about the path of movement thereof.

Initially, a portion of the photoconductive surface passes through charging station A. At charging station A, a corona generating device in accordance with the present invention, indicated generally by the reference numeral 200, charges the photoconductive surface to a relatively high substantially uniform potential.

Next, the charged portion of the photoconductive surface is advanced through imaging station B. At imaging station B, a document handling unit indicated generally by the reference numeral 15, positions original document 16 facedown over exposure system 17. The exposure system, indicated generally by reference numeral 17 includes lamp 20 which illuminates document 16 positioned on transparent platen 18. The light rays reflected from document 16 are transmitted through lens 22. Lens 22 focuses the light image of original document 16 onto the charged portion of the photoconductive surface of belt 10 to selectively dissipate th charge thereof. This records an electrostatic latent image on the photoconductive surface which corresponds to the information areas contained within the original document. Thereafter, belt 10 advances

the electrostatic latent image recorded on the photoconductive surface to development station C. Platen 18 is mounted movably and arranged to move in the direction of arrows 24 to adjust the magnification of the original document being reproduced. Lens 22 moves in synchronism therewith so as to focus the light image of original document 16 onto the charged portions of the photoconductive surface of belt 10.

Document handling unit 15 sequentially feeds documents from a stack of documents placed by the operator in a normal forward collated order in a document stacking and holding tray. The documents are fed from the holding tray in seriatim, to platen 18. The document handling unit recirculates documents back to the stack supported on the tray. Preferably, the document handling unit is adapted to serially sequentially feed the documents, which may be of various sizes and weights of paper or plastic containing information to be copied. The size of the original document disposed in the holding tray and the size of the copy sheet are measured.

While a document handling unit has been described, one skilled in the art will appreciate that the size of the original document may be measured at the platen rather than in the document handling unit. This is required for a copying or printing machine which does not include a document handling unit, or when one is making copies of A3 or 11" × 17" documents where the document handler has to be raised up from the platen and the oversized document manually placed on the platen for copying.

With continued reference to Figure 1, at development station C, a pair of magnetic brush developer rollers, indicated generally by the reference numerals 26 and 28, advance a developer material into contact with the electrostatic latent image. The latent image attracts toner particles from the carrier granules of the developer material to form a toner powder image on the photoconductive surface of belt 10.

After the electrostatic latent image recorded on the photoconductive surface of belt 10 is developed, belt 10 advances the toner powder image to transfer station D. At transfer station D, a copy sheet is moved into contact with the toner powder image. Transfer station D includes a corona generating device 30 which sprays ions onto the backside of the copy sheet. This attracts the toner powder image from the photoconductive surface of belt 10 to the sheet. After transfer, conveyor 32 advances the sheet to fusing station E.

The copy sheets are fed from tray 34 to transfer station D. The tray senses th size of the copy sheets and sends an electrical signal indicative thereof to a microprocessor within controller 38. Similarly, the holding tray of document handling unit 15 includes switches thereon which detect the size of the original document and generate an electrical signal indicative thereof which is transmitted also to a microprocessor controller 38.

Fusing station E includes a fuser assembly, indicat d generally by the referenc numeral 40, which permanently affixes the transferred powder image to the copy sheet. Preferably, fuser assembly 40 includes a heated fuser roller 42 and backup roller 44. The sheet passes between fuser roller 42 and backup roller 44 with the powder image contacting fuser roller 42. In this manner, the powder image is permanently affixed to the sheet.

After fusing, conveyor 46 transports the sheets to gate 48 which functions as an inverter selector. Depending upon the position of gate 48, the copy sheets will either be deflected into a sheet inverter 50 or bypass sheet inverter 50 and be fed directly onto a second decision gate 52. Thus, copy sheets which bypass inverter 50 turn a 90° corner in the sheet path before reaching gate 52. Gate 48 directs the sheets into a face up orientation so that the imaged side which has been transferred and fused is face up. If inverter path 50 is selected, the opposite is true, i.e., the last printed face is facedown. Second decision gate 52 deflects the sheet directly into an output tray 54 or deflects the sheet into a transport path which carries it on without inversion to a third decision gate 56. Gate 56 either passes the sheets directly on without inversion into the output path of the copier, or deflects the sheets into a duplex inverter roll transport 58. Inverting transport 58 inverts and stacks the sheets to be duplexed in a duplex tray 60 when gate 56 so directs. Duplex tray 60 provides intermediate or buffer storage for those sheets which have been printed on one side and on which an image will be subsequently printed on the side opposed thereto, i.e., the copy sheets being duplexed. Due to the sheet inverting by rollers 58, these buffer set sheets are stacked in duplex tray 60 facedown. They are stacked in duplex tray 60 on top of one another in the order in which they are copied.

In order to complete duplex copying, the previously simplexed sheets in tray 60 are fed to conveyor 59 seriatim by bottom feeder 62 back to transfer station D for transfer of the toner powder image to the opposed side of the sheet. Conveyors 100 and 66 advance the sheet along a path which produces an inversion thereof. However, inasmuch as the bottommost sh et is fed from duplex tray 60, the proper or clean side of the copy sheet is positioned in contact with belt 10 at transfer station D so that the toner powder image thereon is transferred thereto. The duplex sheets are then fed through the same path as the previously simplexed

sheets to be stacked in tray 54 for subsequent removal by the printing machine operator.

Returning now to the operation of the printing machine, invariably after the copy sheet is separated from the photoconductive surface of belt 10, some residual particles remain adhering to belt 10. These residual particles are removed from the photoconductive surface thereof at cleaning station F. Cleaning station F includes a rotatably mounted fibrous brush 68 in contact with the photoconductive surface of belt 10. These particles are cleaned from the photoconductive surface of belt 10 by the rotation of brush 68 in contact therewith. Subsequent to cleaning, a discharge lamp (not shown) floods the photoconductive surface with light to dissipate any residual electrostatic charge remaining thereon prior to the charging thereof for the next successive imaging cycle.

Turning now to an aspect of the present invention, the wide-spread belief is that as an insulating surface approaches a corona wire, it collects charge, builds up its potential, and supresses the potential gradients around the wire, thereby shutting down corona. In fact, in the right configuration, the fields can be made to prevent ion deposits on the insulating surface, so that its potential does not build up enough to suppress corona substantially. For example, we have found that a 1.5 mil diameter wire can deliver corona currents to a ground plane 1.5mm away, even when the wire is taped to a plexiglas sheet. A 10 megohm resistor was connected in between a 2 inch length of the wire and a power supply. At about 5500V on the wire coronode, corona current to the plate measured about 50µA per inch in length. With positive voltage, the corona appeared very uniform along the wire. With negative polarity, corona was comparable to that obtained with a wire spanning an open space. A charging device of this type carries all conducting elements in one plane, namely, on the surface of a printed circuit board or glass. For negative corona, the coronode can be shaped to have "barbs" like sawtooth points to give corona beads at controlled regular intervals. Since the coronode-to-shield spacing can be reduced, (because sagging or singing problems are precluded, and arcing is eliminated) the corona points can be made closer together, for example, about 1.5mm or so. This carries significant advantages of ease of manufacture (no stringing and tensioning of fine wires), unlimited length without sagging or singing of wires, durability (no fragile wires to break), and easy maintenance (a singl surface can be cleaned with alcohol).

In reference to Figures 1 and 2, a flat scorotron 200 is shown that comprises high voltage bus bars 205 and 210 connected to corona lines 212 through overlapping resistor member 230. A screen or reference electrode 215 is disclosed for potential leveling purposes and has a low voltage applied to it. The whole device is fabricated on a susbstrate 220 such as a printed circuit board or glass using photolithographic techniques. For example, a charging device in accordance with the present invention is fabricated by providing a copper clad printed circuit board with a photosensitive overcoating. The printed circuit board is then exposed to a photographic pattern of the conductive elements of the device, such as, the reference electrode, lines or wire(s) and bus bar(s). The board is then developed and etched to produce a composite of the conductive elements on the insulating surface. Resistive material is then deposited on the board to provide a connection between the bus bar(s) and lines or wire(s). The resistive material preferably has a resistance in the range of about 10^6 to 10^{10} ohms per square. The purpose of connecting each coronode separately to the high voltage D.C. power supply is to prevent arcing, but more importantly to maintain uniform independent corona emission from each coronode with application of sufficiently high potential to the bus bar. For example, the use of a single resistor between th power supply and the bus bar with direct connection of each coronode line to the bus bar results in corona emission from only one coronode tip. This is because the threshold potential for corona onset is higher than that for maintaining corona (or "keep-alive"") once it is initiated. Also, current flowing through each resistor drops the voltage at the coronode tip by the product of current and resistance ($\Delta V = I \times R$), which tends to ensur more equal output from each coronode. Once the resistive material is on the board, it is ready for use in any of the stations of a machine requiring ion production. A high voltage D.C. is preferably applied to the bus bar(s) and a relatively low voltage of approximately (1000 V) applied to the screen or reference electrode. This voltage is adjustable to provide the proper surface potential for charging a receiver.

A scorotron made by the above described technique in which pin coronodes and a control electrode are positioned coplanar on the surface of an insulator is shown in Figure 2. Advantageously and unexpectedly, self-biasing of this device is limited, for charging of the insulating substrate will quickly shut off charge flow to it, but will not quench the corona emissions from the pin coronodes. As shown, high voltage negative, D.C. voltage bus bar(s) 205 and 210 are connected to individual pin electrodes or lines 212 by overlapping current limiting resistive material 230 which preferably has a resistivity range of between about 10^6 and 10^{10} ohms. A corona is created at the individual pin tips, and is used for charging a

photoreceptor surface in scorotron fashion. A control electrode 215 has a low voltage applied to it in order to control and predict the potential on the photoreceptor surface. Pins 212 extend toward concave, semi-circular portions of electrode and develop a plasma at their tip when biased against a reference. The pins are preferably spaced 6 mm on center and 3 mm from the concave, semi-circular portions of the electrode whose boundaries are concentric with each pin.

The flat scorotron on glass 200 will operate in some high humidity conditions with less efficiency than desired. Presumably, the glass substrate takes in just sufficient moisture to become conducting enough to reduce the potential gradients around the pin ends. Improvements have been shown by overcoating the device with very thin hydrophobic films, such as fluorocarbons, silicone resins, etc. However, they do not stand up over long periods of time to the corona chemistry of ionized air. A striking effective solution to problems with humidity is to attach a low watt heater, e.g., a resistor, to the back of the device. By heating the device with resistor 211 to about 50° to 60° C, the corona becomes more uniform and stable. At very high relative humidity with no heating, the corona sometimes runs up and down the thin conducting pin instead of staying at the tip. Heating prevents this, even at high ambient relative humidities. Thus, a flat scorotron is disclosed that is not degraded due to high relative humidity, is easy to manufacture and therefore less costly than present scorotron devices, presents no singing and sagging problems, is durable and easy to clean. In addition, to reduce any charging streaks, pins 212 are shown in two rows with one row being staggered 180° out of phase with the other row.

An alternative embodiment of the present invention is shown in Figure 3 as flat scorotron 300. This scorotron is quite similar to scorotron 200 of Figure 2 except that only one row of pins is shown. An insulating substrate 220 has a heating element 330 attached to its back surface and corona pins 212, reference electrode 315, high negative D.C. voltage bus bar 210 etched into its top surface. High voltage bus bar 210 is connected to pins 212 by way of resistive material 230 while power supply 308 is directly connected to reference electrode 315. Heating element 330 adapts the device for effective and efficient use in a wide range of relative humidities. It is believed that D.C. pins or lines 212 have never been used, before the devices of the present invention, on the surface of an insulator because it was thought that the surface adjacent the pins would charge up, suppressing corona,or requiring higher voltages and producing arcs.

In reference to Figures 4 and 4A, a novel charging flat scorotron is shown as 80 that comprises an insulator 81 that supports a high voltage bus bar 83 energized by power supply 88 and connected to a corona wire 82 through an overlapping resistor member 85. An optional screen or reference electrode 87 is disclosed for potential leveling purposes and has a low voltage applied to it. The whole device is fabricated on a thin insulating substrate such as a printed circuit board or glass using photolithographic techniques. For example, a charging device in accordance with the present invention is fabricated by providing a copper clad printed circuit board with a photosensitiv overcoating. The printed circuit board is then exposed to a photographic pattern of the conductive elements of the device, such as, the screen, wire(s) and bus bar. The board is then developed and etched to produce a composite of the conductive elements on the insulating surface. Resistive material is then deposited on the board to provide a connection between the bus bar and lines or wire(s). The resistive material preferably has a resistance in the range of about 10^6 to 10^{10} ohms per square. Once the resistive material is on the board, it is ready for use in any of the stations of a machine requiring negative ion production. A high voltage D.C. is preferably applied to the bus bar and a relatively low voltage (1000 V) applied to the screen. This voltage is adjustable to provide the proper surface potential for charging a receiver.

A scorotron in which pin coronodes and screen electrodes are coplanar on the surface of an insulator is shown in Figures 5 and 6. Advantageously and unexpectedly, self-biasing of this device is limited, for charging of the insulating substrate will quickly shut off charge flow to it, but will not quench the corona emissions from the pin coronodes. As shown, a high voltage negative, D.C. voltage bus bar 95 is connected to individual pin electrodes or lines 93 by current limiting resistive material 94 which preferably has a resistivity range of between about 10^6 and 10^{10} ohms. A corona is created at the individual pins which is used for charging a photoreceptor surface in scorotron fashion. A control screen or electrode 92 has a low voltage applied to it in order to control and predict the potential on the photoreceptor surface. Pins 93 extend toward concave, semi-circular portions of reference electrode 92 and develop a plasma at their tip when biased against a reference. Thus, flat corotron and scorotron devices have been disclosed that are easy to manufacture, present no singing and sagging of wire problems; is easy to clean, does not vibrate and is durable.

It should now be apparent that a flat scorotron device has been disclosed that includes a low watt heater attach d to a surface thereof to eliminate relative humidity sensitivity and stabilize performance. The scorotron device includes a plurality of

conductive lines on a top surface of an insulating substrate that are connected to a high voltage negative source of voltage through an overlapping resistive material that enhances corona from the tip, or free end of each line. The lines face a charge control electrode that has portions that are concentric with the tip ,or free end of each line. A small voltage is applied to the control electrode. In another embodiment, a plurality of lines are shown facing and offset from each other while being separated by a reference electrode in order to control charging streaks. Also disclosed is a flat scorotron that includes pin coronodes and a reference electrode positioned coplanar on the surface of an insulator with the reference electrode serving to control the amount of charge going to a receiver. In yet another embodiment of the present invention, a line coronode is disposed on a flat, insulating, substrate and connected to a high voltage source through current-limiting resistive material. A reference electrode having a low voltage applied to it can be included with this device if desired.

While this invention has been described with reference to the structures disclosed herein, they are not confined to the details as set forth and are intended to cover modifications and changes that may come within the scope of the following claims.

Claims

1. A D.C. corona charging device for emitting a uniform discharge of corona to a receptor surface comprising:

an insulating substrate;

corona generating means positioned on a surface of said insulating substrate;

high voltage generating means connected to said corona generating means; and

resistive material means positioned between said high voltage generating means and said corona generating means.

2. The corona charging device of claim 1, further comprising biased electrode means coplanar with said corona generating means adapted to control the potential placed on said receptor surface by said corona generating means.

3. The corona charging device of claim 1 or claim 2, further comprising heating means placed on a surface, preferably a bottom surface, of said insulating substrate and adapted to minimize the effects of relative humidity on said charging device.

4. The corona charging device of any preceding claim, wherein said corona charging device comprises a single integral member.

5. The corona charging device of claim 4, wherein said integral member is substantially flat.

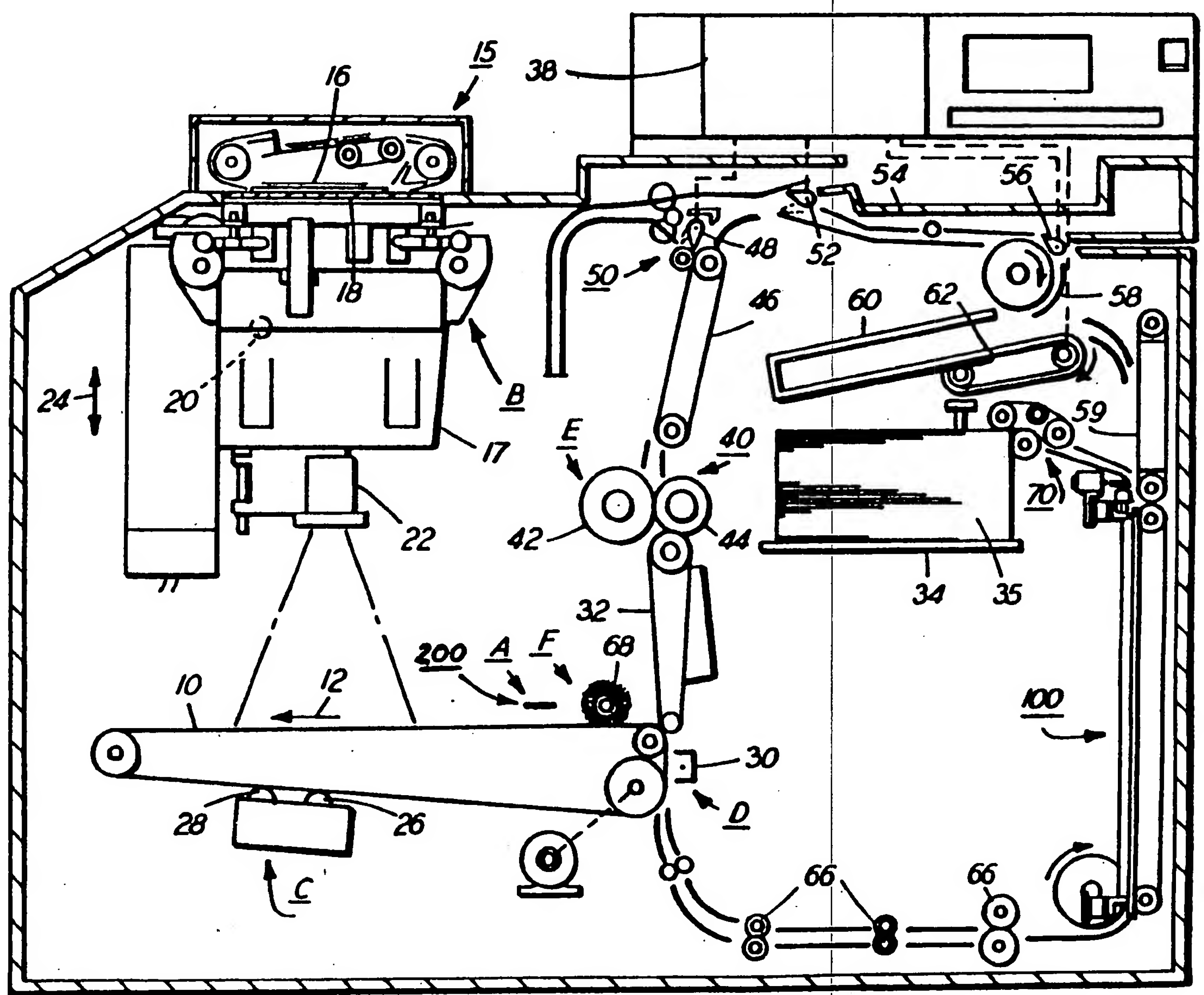
6. The corona charging device of any preceding claim, wherein said corona generating means comprises a plurality of conducting lines.

7. Th corona charging device of claim 6, wherein said electrode means includes concave, semi-circular portions positioned adjacent end portions of said conducting lines.

8. The corona charging device of any preceding claim, wherein said corona generating means comprise a series of pins.

9. The corona charging device of claim 8, including at least two rows of said pins.

10. The corona charging device of claim 9, wherein said at least two rows of pins have individual pins of one row staggered in relation to individual pins of another row.



10
11
12
15
16
17
18
20
22
24
26
28
30
32
34
35
38
40
42
44
46
48
50
52
54
56
58
59
60
62
66
66
68
70
100
200
A
B
C
D
E
F

FIG. 1

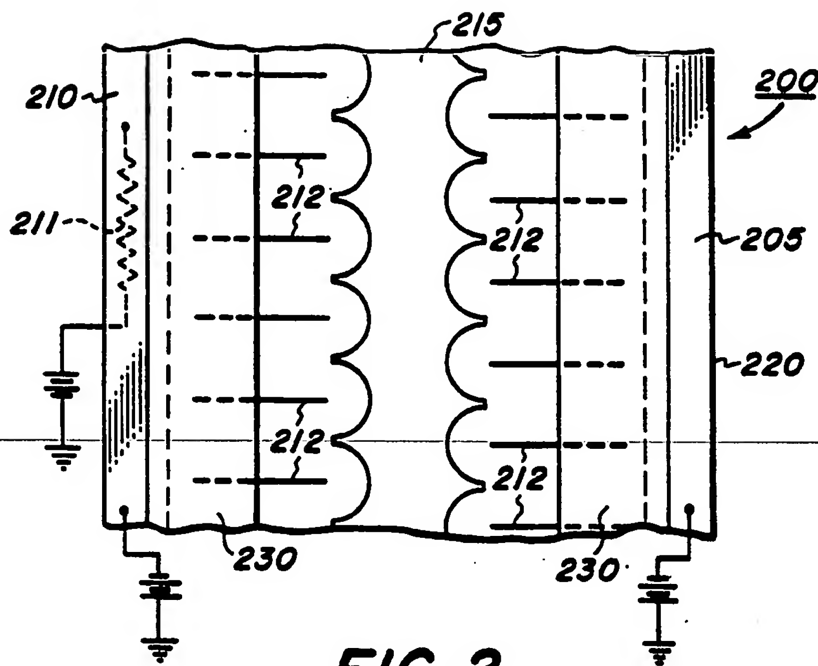

215
200
210
211
212
212
205
220
212
212
230
230

FIG. 2

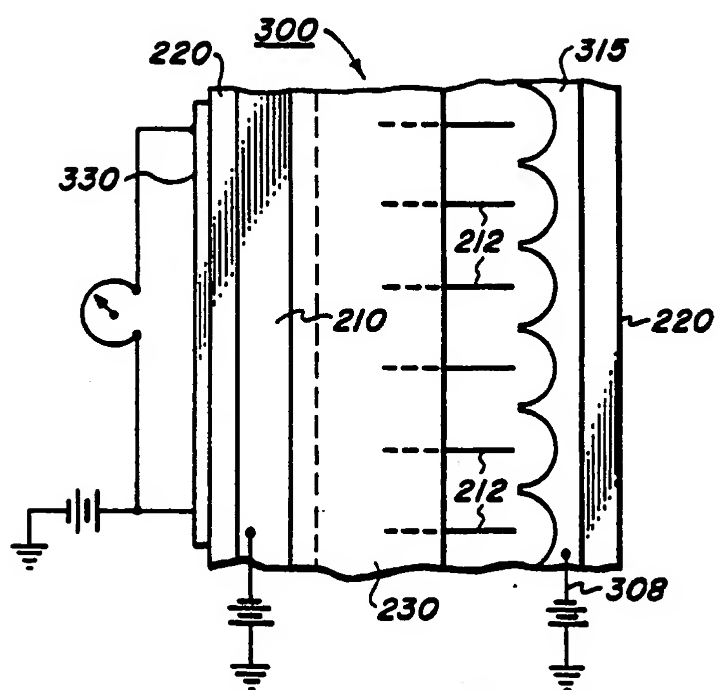

300
220
315
330
212
210
220
212
230
308

FIG. 3

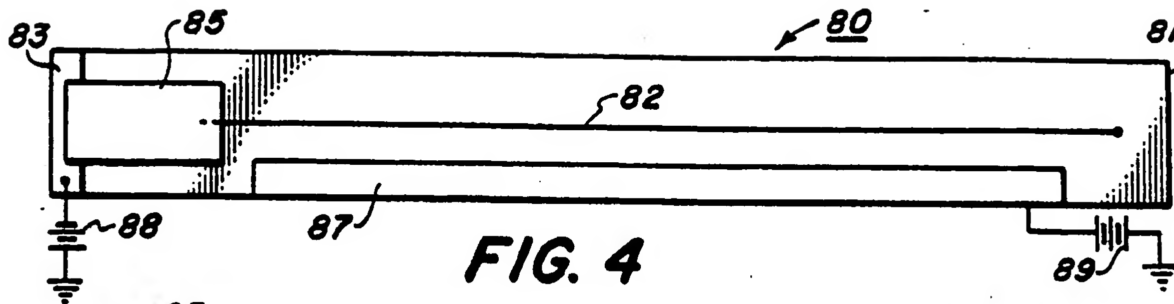


FIG. 4

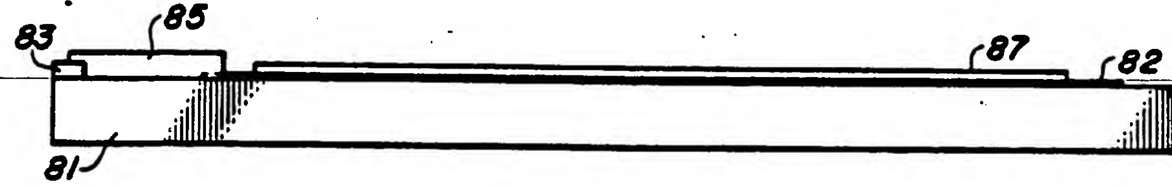


FIG. 4A

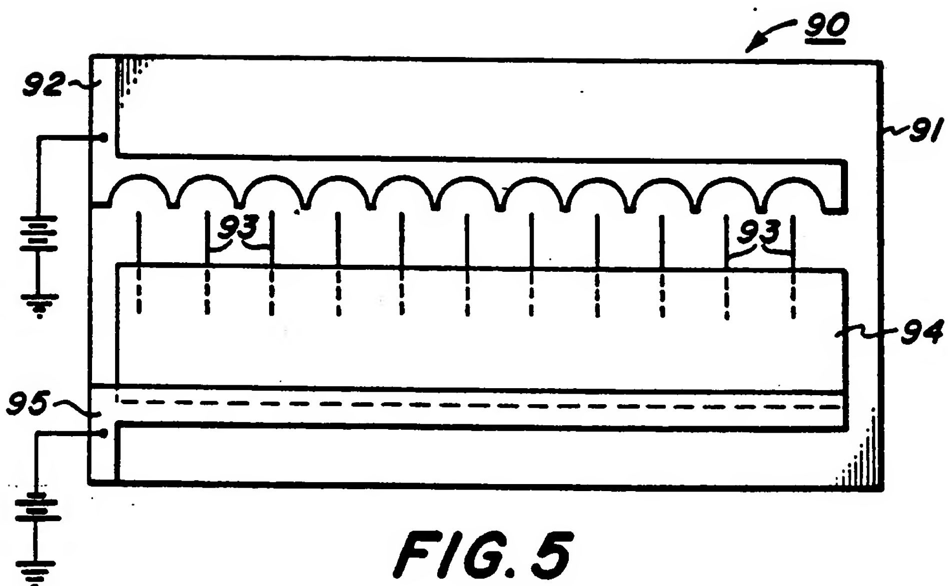


FIG. 5

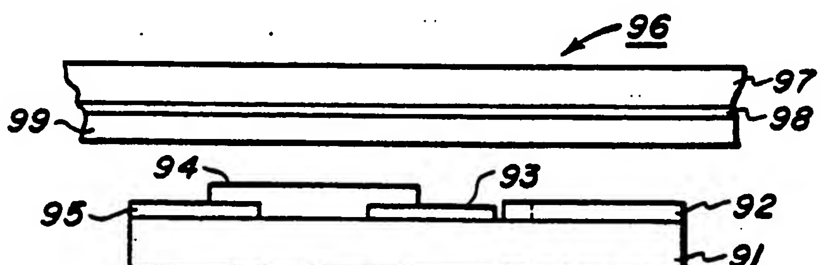


FIG. 6

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 87 31 1271

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
A	PATENT ABSTRACTS OF JAPAN, vol. 10, no. 52 (P-432)[2109], 28th February 1986; & JP - A - 60 195 563 (RICOH) 04-10-1985	1	G 03 G 15/02
A	PATENT ABSTRACTS OF JAPAN, vol. 10, no. 271 (P-497)[2327], 16th September 1986; & JP - A - 61 94072 (RICOH) 12-05-1986	1,3	
A	PATENT ABSTRACTS OF JAPAN, vol. 10, no. 180 (P-471)[2236], 24th June 1986; & JP - A - 61 27568 (CANON) 07-02-1986	1,3	
D,A	US-A-4 057 723 (SARID et al.) * figures 1-6 *	1	
A	DE-B-2 064 545 (HOECHST) * figure 2 *		

TECHNICAL FIELDS SEARCHED (Int. Cl.4)

G 03 G 13/00
G 03 G 15/00
H 01 T 19/00

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
BERLIN	23-03-1988	HOPPE H

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document